A GENERALIZED LOGICAL FORMAT FOR INTER-CALIBRATED BRIGHTNESS TEMPERATURES FOR THE GLOBAL PRECIPITATION MEASUREMENT MISSION

Erich Franz Stocker
John Stout
Christian Kummerow
Wesley Berg

NASA/Goddard Space Flight Center, code 610.2,Greenbelt MD
George Mason University, Fairfax VA
Colorado State University, Ft. Collins, CO
Colorado State University, Ft. Collins, CO

1. INTRODUCTION

With the launch of the Tropical Rainfall Measuring Mission from Tanegashima Space Center in Tangashima Japan in 1997, a number of different groups have attempted to apply radar/radiometer data from this non-polar orbiting satellite to intercalibrate data from the polar orbiting radiometers. As an important consequence of these efforts the Global Precipitation Measurement (GPM) mission [1] included inter-calibration of brightness temperatures of multi-radiometers as a formal requirement. This paper will summarize a prototype of intercalibration that has emerged as part of the GPM effort in intercalibration. It will also provide information about a generic format for an incalibrated brightness temperature (T_c) that will be used for the GPM mission.

2. GLOBAL PRECIPITATION MEASUREMENT MISSION

GPM is an international mission composed of a core satellite provided through a joint National Aeronautics and Space Administration (NASA) and Japan Exploration Agency (JAXA) partnership. This satellite will be launched into 65^{o} inclined orbit. In addition the mission contains a number of constellation satellites provided by U.S. national as well as international partners (e.g. France/India Megha-Tropiques). GPM augments these space-borne with a ground validation effort using ground assets provided by a number of U.S. national and international partners.

GPM has undertaken has a number of intercalibration efforts under study. Most of these activities are coordinated by an intercalibration working group that is part of the many science activities carried out by the Precipitation Measurement Missions (PMM) science team under the leadership of the PMM project scientist and the TRMM project scientist. In 2005, the Precipitation Processing System (PPS) and a scientist at the Colorado State University, School of Atmospheric Science started an intercalibration prototyping effort which sought to test concepts key to an eventual GPM approach. [2]

3. INTERCALIBRATION OF RADIOMETER BRIGHTNESS TEMPERATURE PROTOTYPE

In 2005 a group at Colorado State University and PPS established a partnership to develop an intercalibation prototype based on using the TRMM TMI as a “calibration” source to create intercalibrated brightness temperatures for the JAXA radiometer on Earth Observing System Aqua satellite (AMSRE), the SSM/I sensors in the DMSP series, and the radiometer on WindSat. This intercalibrated brightness temperature is designated as a 1C level of processing and the intercalibrated brightness temperature is designated as T_c. TMI given its 35 degree inclination afforded many coincident overpass opportunities with the other radiometers which were polar orbiting. [2] These coincident opportunities were key to a successful intercalibration effort. The aim of intercalibration is the creation of consistent datasets from many instruments usually with very different characteristics and always different scan angles.

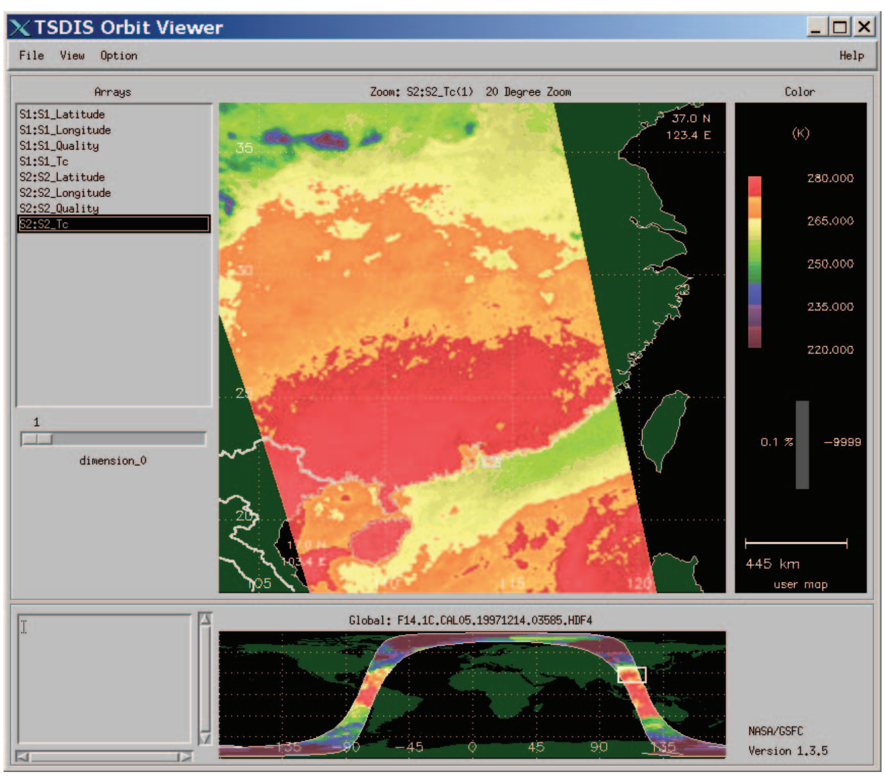
CSU developed the intercalibration code. This code uses TMI as a reference (as a surrogate to the GPM Microwave Imager [GMI]) to intercalibrate various SSM/I sensors. The code is based on open ocean regions jointly observed within 10 minutes by both TMI and an SSM/I. It uses a radiative transfer calculation to account for channel and view angle differences . The result is a curve of offsets as a function of T_b for each SSM/I sensor and channel. [2][3] Currently, AMSRE and Windsat have no TMI intercalibrations applied but are put into the standard 1C format and also re-orbitized.

PPS developed the code for reorbiting all the radiometer data into orbits that were not split at the equator, this was part of the generalization effort. PPS also developed supporting sun angle code as well as the code to format the output.[3] The creation of a generalized, easy to use logical format for the T_c

products was an important aspect of the prototype. It was an aim of this part of the prototype to afford the precipitation community the opportunity to use this format in their work and provide feedback on its advantages and disadvantages.

The 1C products for TMI, AMSRE, F8-F15, and Windsat are routinely produced at PPS. Rainmaps using the 1C products are produced at Colorado State University. The 1C products from all the sensors as well as the rainmaps are available through the CSU website. [2]

From a format perspective the 1C format is designed to store a variety of data types while being as simple as possible. Currently formats exist for SSM/I, TMI, AMSR-E SSM/IS, WindSat, and MADRAS. A user who learns one data type in this format can then use other data types without learning a new format. It was designed to handle multiple swaths, one per sensor geometry. It can handle any number of pixels, conical or crosstrack, incidence angles, and scan period. For example, SSM/I has 2 different swath types: low frequency and high frequency. Figure 1 is an image of a reorbitized, intercalibrated, 1C product.for SSMI on F14.



4. REFERENCES

[1] Hou, A. Y., G. Skofronick-Jackson, C. D. Kummerow, and J. M. Shepherd, 2008: *Global precipitation measurement. In Precipitation: Advances in Measurement, Estimation, and Prediction* (Ed. Silas Michaelides), Springer-Verlag, 540 pp.

[2] Kummerow, C., C.D., Berg, W., and Stocker, E.F., *website: Level 1C Overview*, http://mrain.atmos.colostate.edu/LEVEL1C/level1C_overview.html. 2005

[3] Stout, J., Berg, W., Kummerow, C.,Huffman, G., and Stocker, E., *The GPM Common Calibrated Brightness Temperature Product*, IMAS2005, Space-Based Remote Sensing of the Atmosphere, Beijing, Aug. 2-11, 2005.